What is claimed is:

1. A method for magnetically shielding a charged-particle-beam optical system situated inside a column that extends along an optical axis, the method comprising:

at an axial position relative to the column, disposing an active-canceler coil set adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one coil that is individually electrically energizable; and

electrically energizing the coil set so as to cause the coil set to produce a respective magnetic field of a desired direction and magnitude effective for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the column, that otherwise would extend from outside the column to the optical axis, thereby correcting a distribution of magnetic field within the column to a desired distribution.

2. The method of claim 1, wherein the coil set comprises a single coil.

3. The method of claim 1, wherein the coil set comprises multiple individual coils.

4. The method of claim 1, wherein:

the column defines a lateral opening; and

the coil set is disposed adjacent the opening.

5. The method of claim 4, wherein the coil set is a first coil set, the method further comprising the steps of:

disposing a second active-canceler coil set adjacent the opening opposite the first coil set so as not to obstruct the trajectory of a charged particle beam propagating in the column, the second coil set comprising at least one coil that is individually electrically energizable; and

while electrically energizing the first coil set, electrically energizing the second coil set so as to cause the coil sets to collectively produce a magnetic field of a desired direction and magnitude effective for canceling the external magnetic field.

6. The method of claim 1, wherein:
the coil set comprises multiple individual coils; and
each of the individual coils is rectilinear in configuration.

7. The method of claim 1, wherein the coil set is situated in a transverse plane perpendicular to the optical axis.

8. A method for magnetically shielding a charged-particle-beam optical system situated inside a column that defines an opening and extends along an optical axis, the method comprising:

at an axial position relative to the column and adjacent the opening, disposing an active-canceler coil set adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one coil that is electrically energizable;

disposing a magnetic shield externally to the column, the magnetic shield being made of an anisotropic magnetic material; and

electrically energizing the coil set so as to cause the coil set to produce a respective magnetic field of a desired direction and magnitude effective for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the column, that otherwise would extend from outside the column through the opening to the optical axis, thereby correcting a distribution of magnetic field within the column to a desired distribution.

9. The method of claim 8, wherein the coil set is a first coil set, the method further comprising the steps of:

disposing a second active-canceler coil set adjacent the opening opposite the first coil set so as not to obstruct the trajectory of a charged particle beam

propagating in the column, the second coil set comprising at least one coil that is individually electrically energizable; and

while electrically energizing the first coil set, electrically energizing the second coil set so as to cause the coil sets to collectively produce a magnetic field of a desired direction and magnitude effective for canceling at least a portion of the external magnetic field.

10. The method of claim 8, wherein the magnetic shield is magnetically partitioned.

11. The method of claim 10, wherein the partitions extend in the axial direction.

12. A method for magnetically shielding a charged-particle-beam optical system situated inside a column that extends along an optical axis, the method comprising:

situating at least one active-canceler coil set on or near the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, each coil set being configured, when electrically energized, to produce a respective magnetic field oriented in a prescribed direction; and

electrically energizing the at least one coil set to cause the coil set to produce the respective magnetic field having a magnitude sufficient to cancel at least a portion of a target magnetic field, external to the column, that otherwise would penetrate through the column to the optical axis.

13. The method of claim 12, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction parallel to the optical axis.

14. The method of claim 12, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction that is oblique relative to the optical axis.

15. The method of claim 12, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction that is perpendicular to the optical axis.

16. In a charged-particle-beam (CPB) optical system situated inside a column that extends along an optical axis, a device for reducing, by cancellation, a magnetic field external to the column that otherwise would extend to inside the column, so as to magnetically shield the CPB optical system from the external magnetic field, the device comprising an active-canceler coil set situated at an axial position relative to the column and adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one electrically energizable coil that, when electrically energized, produces a respective magnetic field of a direction and magnitude sufficient for canceling at least a portion of the external magnetic field.

17. The device of claim 16, wherein:
the column defines a lateral opening; and
the coil set is disposed adjacent the opening.

18. The device of claim 17, wherein the coil set is a first coil set, the device further comprising a second active-canceler coil set situated adjacent the opening opposite the first coil set so as not to obstruct the trajectory of a charged particle beam propagating in the column, the second coil set comprising at least one electrically energizable coil that, when electrically energized, produces collectively with the first coil set a magnetic field of a desired direction and magnitude effective for canceling at least a portion of the external magnetic field.

19. In a charged-particle-beam (CPB) optical system situated inside a column that extends along an optical axis, a device for reducing, by cancellation, a magnetic field external to the column that otherwise would extend to inside the column, so as to magnetically shield the CPB optical system from the external magnetic field, the device comprising:

an active-canceler coil set situated at an axial position relative to the column and adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one individual coil that, when electrically energized, produces a respective magnetic field of a direction and magnitude sufficient for canceling at least a portion of the external magnetic field; and

a magnetic shield, made of an anisotropic magnetic material, situated outside the column.

20. The device of claim 19, wherein the coil set is a first coil set, the device further comprising a second active-canceler coil set adjacent the opening opposite the first coil set so as not to obstruct the trajectory of a charged particle beam propagating in the column, the second coil set comprising at least one individual coil that, when electrically energized, produces a respective magnetic field of a direction and magnitude sufficient, in concert with the magnetic field produced by the first coil set, for canceling at least a portion of the external magnetic field.

21. In a charged-particle-beam (CPB) optical system situated inside a column that extends along an optical axis, a device for shielding the CPB optical system from a magnetic field external to the column that otherwise would extend to inside the column, the device comprising at least one active-canceler coil set situated on or near the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, each coil set being configured to be electrically energized and, when electrically energized, to produce a respective magnetic field

oriented in a prescribed direction and having a magnitude sufficient to cancel at least a portion of the external magnetic field.

22. The device of claim 21, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction parallel to the optical axis.

23. The device of claim 21, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction that is oblique relative to the optical axis.

24. The device of claim 21, wherein the at least one coil set is oriented relative to the column to produce a respective magnetic field having a direction that is perpendicular to the optical axis.

25. The device of claim 21, further comprising a magnetic shield situated outside the column.

26. The device of claim 25, wherein the magnetic shield is made of an anisotropic magnetic material.

27. A charged-particle-beam (CPB) microlithography apparatus, comprising:

a CPB optical system extending along an optical axis;

a column containing the CPB optical system; and

a device for reducing, by cancellation, a magnetic field external to the column that otherwise would extend to inside the column, so as to magnetically shield the CPB optical system from the external magnetic field, the device comprising an active-canceler coil set situated at an axial position relative to the column and adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one

coil that can be electrically energized to produce a respective magnetic field of a direction and magnitude sufficient for canceling at least a portion of the external magnetic field.

28. A charged-particle-beam (CPB) microlithography apparatus, comprising:

a CPB optical system extending along an optical axis;

a column containing the CPB optical system;

an active-canceler coil set situated at an axial position relative to the column and adjacent a wall of the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, the coil set comprising at least one coil that can be individually electrically energized to produce a respective magnetic field of a direction and magnitude sufficient for canceling at least a portion of the external magnetic field; and

a magnetic shield, made of an anisotropic magnetic material, situated outside the column.

29. A charged-particle-beam (CPB) microlithography apparatus, comprising:

a CPB optical system extending along an optical axis;

a column containing the CPB optical system; and

a device for reducing, by cancellation, a magnetic field external to the column that otherwise would extend to inside the column, so as to magnetically shield the CPB optical system from the external magnetic field, the device comprising at least one active-canceler coil set situated on or near the column so as not to obstruct a trajectory of a charged particle beam propagating in the column, each coil set being configured to be electrically energized and, when electrically energized, to produce a respective magnetic field oriented in a prescribed direction and having a magnitude sufficient to cancel at least a portion of the external magnetic field.

30. A method for magnetically shielding a charged-particle-beam (CPB) system comprising a CPB column and at least one chamber situated relative to an optical axis, the method comprising:

at an optical axial position relative to the system, disposing at least one active-canceler coil adjacent a wall of the system so as not to obstruct a trajectory of a charged particle beam propagating in the system, the at least one coil being electrically energizable; and

electrically energizing the at least one coil so as to cause the coil to produce a magnetic field that cancels at least a portion of an external magnetic field or a magnetic flux, present externally to the system and that otherwise would extend from outside the system to the optical axis within the system, to a desired distribution.

31. The method of claim 30, wherein the chamber is a reticle chamber or an object chamber.

32. The method of claim 30, wherein:

the system defines a magnetic gap; and

the coil is disposed adjacent the magnetic gap.

33. The method of claim 32, wherein the magnetic gap is an opening in the CPB column.

34. The method of claim 33, wherein the coil is a first coil, the method further comprising the steps of:

disposing a second coil adjacent the opening opposite the first coil so as not to obstruct the trajectory of a charged particle beam propagating in the system, the second coil being electrically energizable; and

while electrically energizing the first coil, electrically energizing the second coil so as to cause the coils to collectively produce a magnetic field for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to

the system and that otherwise would extend from outside the system to the optical axis within the system, to a desired distribution.

35. The method of claim 30, wherein the at least one active-canceler coil defines a coil set comprising multiple individual coils that are individually electrically energizable, the method further comprising the step of electrically energizing the coils so as to cause the coil set to produce a respective magnetic field of a desired direction and magnitude effective for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the system, that otherwise would extend from outside the system to the optical axis, thereby correcting a distribution of magnetic field within the system to a desired distribution.

36. The method of claim 30, further comprising the step of disposing a magnetic shield externally to the system, the magnetic shield being made of an anisotropic magnetic material.

37. The method of claim 36, wherein the magnetic shield is magnetically partitioned into partitions.

38. The method of claim 37, wherein the partitions extend in an axial direction.

39. The method of claim 36, wherein the magnetic shield is disposed so as to place the magnetic flux, present externally to the system, in a desired direction along the optical axis.

40. The method of claim 30, further comprising the step of disposing a magnetic shield externally to the system, the magnetic shield being partitioned into partitions extending in a predetermined direction for placing the magnetic flux, present externally to the system, in the predetermined direction.

41. The method of claim 40, wherein the predetermined direction is along the optical axis.

42. The method of claim 30, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction parallel to the optical axis.

43. The method of claim 30, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction that is oblique relative to the optical axis.

44. The method of claim 30, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction that is perpendicular to the optical axis.

45. The method of claim 30, further comprising the step of disposing each coil of the coil set to position the optical axis within each coil.

46. The method of claim 30, further comprising the step of disposing each coil of the coil set to position the optical axis outside each coil.

47. In a charged-particle-beam (CPB) system including a CPB column and at least one chamber situated relative to an optical axis, a device for magnetically shielding the CPB system, comprising at least one active-canceler coil situated at an optical axial position adjacent a wall of the CPB system so as not to obstruct a trajectory of a charged particle beam propagating in the CPB system, the at least one coil being electrically energizable so as to cause the at least one coil to produce a magnetic field sufficient for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the CPB system and that otherwise would extend from outside the CPB system to the optical axis within the CPB system, to a desired distribution.

48. The device of claim 47, wherein the chamber is a reticle chamber or an object chamber.

49. The device of claim 47, wherein:
the CPB system defines a magnetic gap; and
the at least one coil is disposed adjacent the magnetic gap.

50. The device of claim 49, wherein the magnetic gap is an opening in the CPB column.

51. The device of claim 50, wherein the coil is a first coil, the device further comprising a second coil adjacent the opening opposite the first coil so as not to obstruct the trajectory of a charged particle beam propagating in the system, the second coil being electrically energizable so as to cause the first and second coils to collectively produce a magnetic field for canceling at least a portion of the external magnetic field or magnetic flux, present externally to the system and that otherwise would extend from outside the system to the optical axis within the system, to a desired distribution.

52. The device of claim 47, wherein the at least one active-canceler coil is configured as a coil set comprising multiple individual coils that are individually electrically energizable so as to cause the coil set to produce a respective magnetic field of a desired direction and magnitude effective for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the system, that otherwise would extend from outside the system to the optical axis, thereby correcting a distribution of magnetic field within the system to a desired distribution.

53. The device of claim 47, further comprising a magnetic shield disposed externally to the CPB system, the magnetic shield being made of an anisotropic magnetic material.

54. The device of claim 53, wherein the magnetic shield is magnetically partitioned into partitions.

55. The device of claim 54, wherein the partitions extend in an axial direction.

56. The device of claim 53, wherein the magnetic shield is disposed so as to place the magnetic flux, present externally to the system, in a desired direction along the optical axis.

57. The device of claim 47, further comprising a magnetic shield disposed externally to the CPB system, the magnetic shield being partitioned into partitions extending in a predetermined direction for placing the magnetic flux, present externally to the system, in the predetermined direction.

58. The device of claim 57, wherein the predetermined direction is along the optical axis.

59. The device of claim 47, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction parallel to the optical axis.

60. The device of claim 47, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction that is oblique relative to the optical axis.

61. The device of claim 47, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction that is oblique relative to the optical axis.

62. The device of claim 47, wherein the at least one coil is oriented relative to the column to produce a respective magnetic field having a direction that is perpendicular to the optical axis.

63. The device of claim 47, wherein:

the at least one coil is configured as a coil set comprising multiple constituent coils; and

the coil set is disposed so as to position the optical axis within each coil.

64. The device of claim 47, wherein:

the at least one coil is configured as a coil set comprising multiple constituent coils; and

each coil set is disposed so as to position the optical axis outside each coil.

65. A charged-particle-beam (CPB) microlithography apparatus, comprising:

a CPB system including a CPB column and at least one chamber situated relative to an optical axis; and

a device for magnetically shielding the CPB system, comprising at least one active-canceler coil situated at an optical axial position adjacent a wall of the CPB system so as not to obstruct a trajectory of a charged particle beam propagating in the CPB system, the at least one coil being electrically energizable so as to cause the at least one coil to produce a magnetic field sufficient for canceling at least a portion of an external magnetic field or a magnetic flux, present externally to the CPB system and that otherwise would extend from outside the CPB system to the optical axis within the CPB system, to a desired distribution.